Spontaneous Progressive Occlusion of a Large, High-flow Direct Carotid Cavernous Fistula After Partial Treatment with Guglielmi Detachable Coils

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Direct carotid-cavernous fistulas (CCFs) are commonly treated using the transarterial approach with detachable balloons. Occasionally, Guglielmi detachable coils (GDCs) are used in patients with mild steal of flow. The fistula can be obliterated progressively after initial incomplete treatment. It is supposed the GDCs are not suitable for patients with severe steal of flow. We present a 54-year-old woman with high-flow CCF. Balloon embolization of the fistula was tried but failed via both transarterial and transvenous approaches. We used 19 GDCs to obliterate the fistula partially. The initial result was incomplete occlusion. However, complete occlusion of the fistula was found during the follow-up angiogram 2 months after the procedure was performed. We propose that GDCs can be used to treat patients with large, high-flow CCF with severe steal.

Key words: Carotid-cavernous fistula; Embolization; Guglielmi detachable Coils

Most of the direct carotid-cavernous fistulas (CCFs) are caused by head injuries [1]. A direct communication between the cavernous carotid artery and the cavernous sinus occasionally occurs after rupture of a cavernous carotid aneurysm, dissection or iatrogenic injury [2]. The treatment of choice of CCFs is balloon embolization either via the transarterial or transvenous approaches for patients with preservation of parent internal carotid arteries [1-4]. However, this was achieved in only 60 to 88% of patients in reported series [2, 5]. Occasionally, electrothrombosis of the direct CCFs with Guglielmi detachable coils is an alternative method for patients with small CCFs with mild steal of flow [2, 6-9]. Although spontaneous progressive thrombosis of residual fistula after partial occlusion was demonstrated in some series [7, 8], this has never been reported in a patient with large, high-flow CCF with severe steal. This report refers to a patient with large CCF with severe steal treated with GDCs. The partial occlusion of the fistula was found on the initial post-treatment angiograms, however, a follow-up angiogram 2 months after the procedure showed complete obliteration of the fistula.

CASE REPORT

A 54-year-old female had left proptosis, bruit, diplopia and conjunctival chemosis after a blunt head injury. Angiogram (Fig. 1) revealed a large direct CCF with severe steal of flow and nonvisualization of the ipsilateral hemispheric arteries. The fistula was located in the proximal cavernous portion of the left ICA. The venous drainage was toward the superior ophthalmic vein, superior petrosal sinus, inferior petrosal sinus and the contralateral cavernous sinus through the coronal sinus. Transarterial and transvenous (via inferior petrosal sinus) balloon embolization were attempted but the attending physicians failed to navigate the balloon into the cavernous sinus. Patency of the supraclinoid portion of left ICA was confirmed using vertebral artery angiogram with manual compression of the left common carotid artery. Therefore, embolization of the CCF with GDCs was performed. Systemic anticoagulation was achieved by administering an intravenous bolus of heparin (5000 IU). A 6-F guiding catheter was advanced into the proximal left ICA, and a 2-marker Tracker-18 microcatheter (Target Therapeutics, USA) was navigated through the fistula into the cavernous sinus. After the position of the microcatheter tip was secured in the left cavernous sinus, GDCs were introduced through the microcatheter into the cavernous sinus. Periodic checking of the patency of the ICA
and the location of the coils were done using the road-mapping technique and angiograms during the procedure. In total, 19 GDCs (GDC-18 10 mm/30 cm × 1, 8 mm/20 cm × 1, 6 mm/20 cm × 1, GDC-18-soft 3 mm/4 cm × 1, GDC-10 4 mm/10 cm × 4, 4 mm/6 cm × 3, 3 mm/8 cm × 1, 3 mm/6 cm × 1, 3 mm/4 cm × 4, 2 mm/4 cm × 2) were delivered into the cavernous sinus. The immediate postembolization angiogram demonstrated moderate residual flow through the CCF (Fig. 2). Continuous heparinization was maintained for 3 days following the procedure. Follow-up angiogram (Fig. 3) performed 2 months after the procedure showed complete occlusion of the fistula with a small pseudoaneurysm at cavernous portion of left ICA. Proptosis, bruit, and chemosis resolved gradually and eventually disappeared. The patient led an uneventful life thereafter.

**DISCUSSION**

The degree of steal of flow of CCFs can be classified into three grades [7]. Mild steal was defined as normal visualization of the ipsilateral hemispheric arteries with delayed opacification of the cavernous sinus and its drainage. Moderate steal was defined as nearly equal flow through the fistula and toward the ipsilateral hemisphere. Severe steal means no visualization of the ipsilateral hemispheric arteries and supraclinoid ICA whose patency is confirmed using compression study during injection of either vertebral artery or contralateral ICA.

Until recently, the treatment of choice of CCFs was embolization via the transarterial endovascular approach with detachable balloon [1-3, 5, 10]. However, preservation of the parent ICA was achieved in only about 60 to 88% of patients [2, 5, 11]; a percentage that grew from an initial 59% when the technique was first introduced [2]. Failure may occur because the fistular orifice is too small to allow entry or the fistula is located in the lesser curvature side of the cavernous ICA. The ICA may be severely transected or there may be multiple fistular orifices. Bony fragments or foreign bodies inside the cavernous sinus can prevent the inflation of the balloon. The presence of multiple balloons inside the cavernous sinus prevents the navigation of the final balloon. Sometimes, stenotic or tortuous carotid arteries render catheterization impossible [2, 5, 12]. The transvenous approach can be an alternative route for such patients. However, the transvenous approach to treat patients with CCF is often difficult [2, 4, 5]. This is mainly because of the trabeculae of the cavernous sinus, which make navigation through the partitions of cavernous sinus difficult [2]. The other pitfall of the transvenous approach is converting the cavernous sinus into an aneurysm by blocking venous drain without occluding the fistula. Diversion of the venous flow can cause worsening of visualization, venous hypertension, or hemorrhage of the brain [5]. If these technical problems occur, the fistula can be obliterated using occlusion of the ICA. Various kinds of balloon test occlusions have been proposed to test the feasibility of acute ICA occlusion. However, these tests have not been completely reliable. The false negative rates of these tests are still high and some patients may develop delayed ischemic symptoms despite they having passed the test occlusion [13-17]. Therefore, it is important to preserve the patency of ICA during the treatment of CCF.

Since Guglielmi et al reported their experience with GDCs during the treatment of patients with intracranial aneurysms in 1991, more than 10000 aneurysms have been treated using GDCs. However, to the best of our knowledge, only 21 patients with direct CCFs treated with GDCs have been reported in the literature [2, 6-10]. All of them were classified as mild to moderate steals, except one, who was treated by using ICA occlusion [9]. Siniluoto et al
Embolization of Severe Steal CCF with GDCs

concluded that small to medium-sized CCFs (< 3mm) that were not with high flow might be amenable to the treatment by using GDCs. The soft platinum coils exert little force on the surrounding structure and may be easily displaced in a high flow fistula. In addition, when a cavernous sinus is notably dilated and variable in dimensions, closure of the fistula close to the orifice may be difficult or impossible [7].

To the best of our knowledge, this is the first reported case of high-flow direct CCF treated by using GDCs with preservation of the parent ICA. We occluded the outlet of the fistula partially by using large GDCs first, and then filled the residual lumen and the orifice as much as possible. Subtotal occlusion of a fistula may not indicate failure. After a significant reduction of flow, the gradual spontaneous progression of thromboses were documented in patients with CCFs of mild steal [2, 6, 7]. In our patient, moderate residual flow was documented immediately after the procedure. However, complete occlusion of the fistula was noted during the follow-up angiogram 2 months after the procedure. Although a small pseudoaneurysm developed at fistular site, it might become smaller gradually and the incidence of clinically symptomatic pseudoaneurysm was low [11]. We believe that progressive occlusion of high-flow CCFs with severe steal of flow may be expected if the outlets and lumen of fistula are partially obliterated with GDCs. However, more experience is needed to verify the general feasibility of this new application.

REFERENCES

高流量直接型頸動脈海綿竇吻管經高尼米線圈部份栓塞後自發性封閉

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直接型頸動脈海綿竇吻管的治療方式，目前是以經動脈氣球栓塞術為主。極少數無法成功地施行氣球栓塞術的病例，可以使用高尼米線圈栓塞。至目前為止，文獻報告認為中、低流量的吻管才適合以高尼米線圈栓塞。我們報告一54歲女性病人罹患高流量直接型頸動脈海綿竇吻管。經高尼米線圈部份栓塞後，仍有明顯的血液分流通過吻管。但兩個月後的血管攝影發現吻管已自動完全封閉。我們以此推論，高尼米線圈可以用於高流量頸動脈海綿竇吻管。但需要更多的病例經驗來証實其一般可行性。

關鍵詞：頸動脈海綿竇吻管；栓塞術；高尼米線圈